

## Southern Forest Resource Conditions and Management Practices from 1900–1950: Benefits of Research

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**Abstract**—*The vast harvest of the native forests of the South in the 19<sup>th</sup> and early 20<sup>th</sup> centuries created a great need for reforestation and silvicultural knowledge. An emphasis on forestry research that changed the face of the South began with the establishment of the Southern and Appalachian Forest Experiment Stations in 1921. Working under primitive conditions, early researchers provided the information that was used to restore the southern forests. A key to this success was the interaction and cooperation of workers in universities, State service, Federal service, and forest industry.*

### INTRODUCTION

Although southern pines were the basis for the oldest forest industry in America, the forests of the Southern United States were little influenced by humans until the mid-19<sup>th</sup> century. Longleaf pine (*Pinus palustris* Mill.) was the focus of the early lumber business in the South—primarily for export. A decline in the supply of longleaf pine in the Carolinas was noted about 1860. However, intensive harvesting of this species continued to spread westward across the South throughout the early 1900s. As the harvesting of the 90 million acres of mature longleaf stands moved westward, the development of railroad logging continued to increase the efficiency of harvesting. Thus it is not surprising that in the west gulf region the supply of seed trees became insufficient to regenerate the species. Across the southern Coastal Plain, loblolly pine (*P. taeda* L.) began to naturally regenerate cutover longleaf pine sites. However, many millions of acres of forest land in both the mountains and Coastal Plains had already been converted to agriculture. Much of this land was found to be unsuitable for row crops and was abandoned. Other large areas of cutover lands that were not converted to agriculture needed reforestation. This cutover

land was considered by many as open rangeland and was heavily grazed by cattle and hogs. These activities further increased the difficulty of reforestation. The rebuilding of the forest resource had become a major challenge as well as a silvicultural opportunity.

This chapter describes the initiation and the scope of forest research in the South through the World War II era. Because there is a great deal of information about the postwar period, it is necessary to limit the scope of the paper to the earliest part of the period. The objectives of the paper are to provide a sense of the research environment during the period, to describe the major scientific accomplishments of the period, and to identify some of the scientists who contributed to these accomplishments.

### THE NEED FOR MANAGEMENT

George W. Vanderbilt was early to recognize the need for reforestation of cutover land, and hired Gifford Pinchot as a forester for his Biltmore Estate near Asheville, NC. Dr. Carl Schenck, who replaced Pinchot in 1885, established the first scientifically based forestry school in this country on the Biltmore Estate. Through his school and influence, Dr. Schenck became one of the founders of modern American forest management, and the Biltmore Forest School became known as the cradle of scientific forestry in America.

Northern investors came into the South following the Civil War. Late in the 1880s, they purchased land inexpensively and built mills for processing timber. For example, the Great Southern Lumber Company in Bogalusa, LA, ran four 8-foot band saws at full speed for more than two decades, producing 1 million board feet of lumber every 24 hours (Kerr 1958).

Late in the post-Civil War period while lumber production in the South was at an all-time high, a few farsighted individuals began to work on a reforestation program that would provide for a continuing forest resource. In 1913, Henry Hardtner, who became known as the “father of forestry in the South,” established plots on the first reforestation reserve in Urania, LA, to

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support and guide pine reforestation (Wheeler 1963). Hardtner, as President of the Urania Lumber Company, placed 25,719 acres of his cutover forest lands under a reforestation contract with the State of Louisiana. It was Hardtner's belief that cutover lands offered long-term opportunities for profit (Maunder 1963). William G. Greeley, Chief Forester of the U.S. Forest Service, remarked that even by 1920 neither foresters nor lumbermen had any real concept of the reproductive vigor of logged-over forests, or of how the growth rate was increasing as young trees replaced old forests (Maunder 1963). In recognition of this situation, a Cut-Over Land Conference of the South held in New Orleans in 1917 promoted the sensible use of cutover lands in which forestry, farming, and grazing all had a place in the economic use of forest lands.

### ESTABLISHMENT OF RESEARCH PROGRAMS

The need for additional research was becoming apparent in 1915 when Samuel T. Dana of the U.S. Forest Service, in an effort to identify problems that needed study, established large plots on Hardtner's reserve. In 1917, the Yale School of Forestry started sending its graduating classes to Urania for 3 months of practical training. This program continued for several decades. Students under the direction of Professor H.H. Chapman established longleaf pine thinning and fire plots as well as other related studies (Wheeler 1963). The early results of Chapman's Urania studies were summarized in "Factors Determining Natural Regeneration of Longleaf Pine on Cutover Lands in LaSalle Parish, Louisiana" (Chapman 1926).

In 1921, the Forest Service of the U.S. Department of Agriculture established the Southern and Appalachian Forest Experiment Stations at New Orleans, LA, and Asheville, NC, respectively. The Southern Forest Experiment Station (Southern Station) was primarily responsible for research in the southern pine types (from South Carolina to east Texas), and the Appalachian Forest Experiment Station (Appalachian Station) for the mountain hardwood types. The two research stations employed about two-thirds of the professional foresters working in the Southern United States. Although these foresters (Forbes, Hine, Shivery, Hadley, and Wyman of the Southern Station and Frothingham, McCarthy, Korstian, and Haasis of the Appalachian Station) worked under primitive conditions and with annual budgets of < \$20,000 per station, they accomplished

some remarkable things. A few other pioneering researchers joined the stations in the mid-twenties, but little expansion of the program occurred until Congressional passage of the McSweeney-McNary Forest Research Act of 1928. Passage of this act signaled a general appreciation of the need for forestry research efforts to deal with the many problems resulting from the large-scale harvesting of the native forests of the Southern United States.

Prior to World War II, there was little forestry research in the South apart from the programs established by the Federal Government. Notable exceptions were programs at the Biltmore Estate at Asheville, NC, and the Yale School of Forestry's training program at Urania, LA. Forestry programs at other universities in the South were just being established.

### SUCCESSES OF EARLY RESEARCH

#### *Reforestation*

By conservative estimate, 13 million acres (about 10 percent) of southern forest land were in need of planting as late as 1954 (Wakeley 1954). The technology needed to undertake this massive effort was developed in the 1920s and 1930s with meager resources. Reforestation research began to flourish when Philip Wakeley arrived at the Southern Station in 1924 and was assigned to the Bogalusa, LA, substation, which was supported by the Great Southern Lumber Company. Following a visit to the thriving forestry project of the Urania Lumber Company, the Great Southern Lumber Company had initiated an historic planting program in 1920. The company planted 800 acres with loblolly pine seeds sown on ridges made with mule and plow. The success of this first large-scale commercial planting was the impetus for experimentation and observation that resulted in greatly improved technology (Heyward 1963b).

With help from Great Southern Lumber Company personnel, Philip Wakeley developed successful nursery production and outplanting techniques. Wakeley's collaborative research with Mary Nelson, Plant Physiologist, of the Southern Station (Nelson 1938) and Lela Barton of the Boyce Thompson Institute (Barton 1928) was critical to development of the needed understanding of pine seed testing, treating, and storing technology. J.K. Johnson, Great Southern Lumber Company forester and one of the Nation's first industrial foresters, supplied the labor and planting stock for many of the experiments. An

outstanding result was the publication “Artificial Reforestation in the Southern Pine Region,” which has guided pine planting for the entire South since the Civilian Conservation Corps (CCC) days (Wakeley 1935a). This 1935 publication became the basis of an expanded version “Planting the Southern Pines,” which was published after the war and became the primer for reforestation in the South (Wakeley 1954).

Reforestation research was transferred from Bogalusa to Alexandria, LA, during the CCC period with establishment of the Forest Service’s Stuart Nursery at nearby Pollock. With the help of CCC crews, nearly two-thirds of a million seedlings were outplanted in research tests on the Palustris Experimental Forest and surrounding Kisatchie National Forest (Wakeley and Barnett, in press).

A colorful individual who made a unique contribution to the development of reforestation technology was F.O. (Red) Bateman, Chief Ranger of the Great Southern Lumber Company. Bateman had no formal training, but between 1921 and 1936, he made notable contributions to early fire-fighting practice and fire suppression work. He also developed the details of the first successful large-scale nursery and associated planting technology for the southern pines (Wakeley 1941, 1976). Wakeley (1976) said he was “one of the greatest silviculturists the South has known” and “thousands of acres of Great Southern’s plantations, and in a real sense, most of the pine plantations in the South, stand as a monument to his genius.”

In cases where some remnant seedlings or stands remained, the research R.R. Reynolds conducted at the Crossett Experimental Forest provided management guidelines for the use of uneven-aged and selection methods. This research program became recognized nationally and was an early example of a partnership between forest industry and Government research (Reynolds 1951).

### Fire

The effect of fire in forests was a matter of great interest and controversy among early foresters. In 1916, results of observations in Henry Hardtner’s reserve were published in the Louisiana Conservation Commission biennial report (Wheeler 1963). The findings are summarized as follows: (1) fires occurring from December 1 to March 1 are not destructive to longleaf pine; (2) fire will kill shortleaf pine

(*P. echinata* Mill.) seedlings < 4 years of age, but not after that age; and (3) although longleaf seedlings will survive a fire, they will not survive damage by hogs.

Based on his observations at Urania, Professor Chapman of Yale advocated the use of fire in longleaf stands. He stated that fire controlled brown-spot needle disease (*Mycosphaerella dearnessii* Barr.) and promoted early height growth (Wakeley and Barnett, in press). Research station researchers did not agree with Chapman’s conclusions. The Southern Station’s study of a 1928 wildfire in an 800-acre longleaf pine plantation of the Great Southern Lumber Company indicated that brown-spot would quickly reinvade longleaf plantations, but that Chapman was correct in his contention that fire benefited initiation of longleaf pine seedling growth. Professor Chapman’s research changed the prevailing opinion that all fire was bad. Chapman strongly supported the use of fire in longleaf pine reforestation and management, stating that “. . . prohibition of use of controlled fire will effectively exterminate this species in the region described” (Chapman 1941).

During the 1930s, other fire studies resulted in a tentative fire danger meter for the longleaf-slash pine (*P. elliotii* Engelm.) type. George Waltner, sociologist, and Dr. John Shea, psychologist, were contracted to study the forest fire-starting motives of local residents (Wheeler 1963). Dr. Shea reported that many of those who started fires craved excitement in “an environment otherwise barren of emotional outlets” (Kerr 1958).

### Forest Survey

Early surveys of forest resources were mandated by Congress. In 1930, Congress appropriated funds to begin a forest survey of the southern hardwood region. “The Trees of the Bottom Lands of the Mississippi River Delta Region,” by John Putman and Henry Bull (1932), was issued as the first in the Southern Station’s Occasional Paper series. This publication was well received and later led to the establishment of the station’s bottomland hardwood research center at Stoneville, MS.

The Southern Forest Survey was authorized by the McSweeney-McNary Act and began in 1931. I.F. “Cap” Eldredge assumed direction of this survey at the Southern Station and significant resources were allocated to the work. Beginning in 1934, a series of releases established the value of the effort. New releases were eagerly awaited, and



these became the basis for the pulp industry's move into the South (Wheeler 1963). By the end of 1942, the Southern Forest Survey had "grid-ironed the States from South Carolina and part of Tennessee south and west to the western boundaries of the southern trees, and 53 releases had been issued, which in turn were reworked into formal State reports issued from the Government Printing Office" (Wakeley and Barnett, in press). This was a tremendous task (more than 215 million acres were inventoried) and its results provided the basis for the development of forest industry across the South.

### **Hardwood Management**

Early hardwood research was focused at the Appalachian Station's Bent Creek Experimental Forest, which was established in 1925 on a portion of land that the Forest Service purchased from George Vanderbilt. Most of the land purchased from Vanderbilt became the Pisgah National Forest, but a portion was set aside for the experimental forest. Earl Frothingham and F.W. Haasis assumed responsibility for experimental tests established by Pinchot and Schenck on Vanderbilt's Biltmore Estate. Jesse Buell arrived in the mid-1920s and initiated studies to determine how the cutover areas of the Southern Appalachians could be managed. Buell published information dealing with silvicultural practices needed to manage hardwoods, and with Margaret Abell published reports of methods for estimating future volumes of Appalachian hardwoods and the effect of fire on hardwood quality (Buell 1928, Buell and Abell 1935). Fire was found to play a significant role in the introduction of heart rot in hardwoods (Haig 1946). Margaret S. Abell, for many years the only woman to be employed as a professional forester by the Forest Service, was stationed at Bent Creek during the 1930s.

There was little other hardwoods research in the South before the World War II period. The Southern Station was not allowed to conduct hardwood research before late 1928 when the State of Louisiana provided \$5,000 for the salary and expenses of G.H. Lentz of New York State College of Forestry, assisted by John Putman, to begin an economic survey of the hardwood situation in Louisiana.

### **Insects and Diseases**

In 1925, the Bureau of Entomology established a small insectary at Bent Creek in the Appalachian Station and assigned R.A. St. George to breed and observe generation after generation of such

"public enemies" as the southern pine beetle (*Dendroctonus frontalis* Zimmermann). T.E. Snyder of the Southern Station began to publish information about the influence of environmental factors on the development of southern pine beetle populations in the mid-1930s (Snyder 1935).

At Bogalusa, Wakeley (1935b) worked out the life history of the Nantucket pine tip moth (*Rhyacionia frustrana* Comstock) in 1927–28, a significant accomplishment since he had little entomological training.

Brown-spot needle blight was a major disease affecting longleaf pine seedlings in nurseries and after outplanting. At the suggestion of Dr. Carl Hartley of the Bureau of Plant Industry in Washington, DC, Wakeley initiated a study evaluating the use of the fungicide Bordeaux as a potential control. The tests were very successful, and a Bordeaux mixture became the standard spray treatment for brown-spot. The assignment of Paul V. Siggers to the Southern Station in 1928 to conduct research on brown-spot needle blight and fusiform rust (*Cronartium quercuum* f. sp. *fusiforme*) began a period of significant accomplishment. His research culminated in papers such as "The Brown-Spot Needle Blight of Longleaf Pine" (Siggers 1932) and "Weather and Outbreaks of the Fusiform Rust of Southern Pines" (Siggers 1949). Siggers (1940) also proposed the name "little-leaf disease of pines" for the diseased condition of shortleaf pine in northcentral Alabama.

The valuable chestnut [*Castanea dentata* (Marsh.) Borkh.] was eliminated from the Appalachian forests by the blight caused by *Endothia parasitica* (Murrill) Anderson & Anderson. The blight swept southward and westward into the forests of the Southern Appalachian Mountains in the 1920s effectively eliminating the species from these forests (Frothingham 1924). Studies were established to determine how long the dead trees would be useful as sources of tannin and pulpwood. It was found that their insect-and-disease-resistant wood would ordinarily be useful for about 30 years after death of the trees (Haig 1946).

### **Products**

An early problem experienced in the use of second-growth lumber was the rapid development of a blue stain fungus that greatly reduced the value of unseasoned (not kiln dried) lumber. Ralph Lindgren reported in 1928 and 1929 that

treatment of lumber with ethyl mercuric chloride eliminated the blue stain problem (Wheeler 1963). Lindgren's accomplishment had a great impact on the forest products industry. Within 2 years, the results were applied in over 200 pine and hardwood mills across the country and were being put into use abroad (Lindgren and Verrall 1950).

Another early effort focused on improvements to chipping for resin production in the naval stores industry. Len Wyman was assigned to a substation in Stark, FL, in 1921. Wyman's work changed the gum naval stores industry across the South. He worked effectively with industry to reduce the size of the chipping streak. This reduction resulted in a substantial saving in labor and in tree mortality and also increased considerably the length of time a tree could be worked (Wakeley and Barnett, in press). To increase production of gum naval stores for war needs, the station intensified experiments with chemical stimulation, and in a few years again revolutionized naval stores techniques by introducing developments in this field. As old-growth stands suitable for chipping were cut, the stumps resulting from harvesting were distilled for naval stores products (Kerr 1958).

In 1937, the South had a total of 38 pulpmills in operation or under construction. Much of the credit for the rapid expansion of pulping southern wood goes to Dr. Charles Herty (Heyward 1963a). Herty served as head of the Department of Chemistry at the University of North Carolina and was elected president of the American Chemical Society in 1915. He became enthralled with the prospect of producing newsprint from southern pines and established a laboratory (Industrial Committee of Savannah, Inc.) in Savannah, GA, to evaluate pulping technology. He traveled widely to promote the use of second-growth timber as a source of pulp for newsprint. His showmanship and genius for publicity developed confidence in the potential to produce paper from southern pine pulp.

### **Mensuration and Statistics**

One of the earliest studies undertaken by the Southern Station made use of temporary sample plots in even-aged, second-growth stands throughout the South. The data obtained were compiled into normal volume, stand, and yield tables for unmanaged second-growth loblolly, shortleaf, longleaf, and slash pines. The tables were published in 1929 as Miscellaneous Publication 50 of the U.S. Department of Agriculture (U.S. Department of Agriculture,

Forest Service 1929). They were used widely and contributed greatly to an understanding of the growth potential of the four principal southern pines and the practical forest management of the pine types (Wakeley and Barnett, in press). This publication was long out of print and copies were virtually museum pieces when it was reprinted as a result of customer demand in the 1970s.

A number of spacing and thinning studies were established with both pines and hardwoods. Early on, there was no replication in these or any other studies. Nevertheless, they did begin to provide good management guidelines. With the assignment of Roy Chapman to the Southern Station in 1927, practical statistical techniques began to be more widely applied. Chapman was assigned to train under Francis X. Schumacher for 3 years and developed a friendship with R.A. (later Sir Ronald) Fisher, one of the founders of modern statistics, whose published works and personal advice did much to shape Chapman's and the station's scientific direction (Wakeley and Barnett, in press).

### **Genetics and Tree Improvement**

In 1922, Professor H.H. Chapman published his remarkable treatise on studies establishing the existence of a natural hybrid between longleaf and loblolly pine, Sonderegger pine (*P. x sondereggeri* H.H. Chapm.) (Chapman 1922). He named the hybrid after V.H. Sonderegger, who was then Louisiana State Forester.

In 1929, Wakeley performed the first controlled hybridization of southern pines, a cross of longleaf and slash pine (Wakeley 1981). He also established the first provenance test of southern pine. Planted in 1926–27 and remeasured at 15 years of age, loblolly pine from four different seed sources showed a striking range in wood production (Wakeley 1944). Because of the detailed original descriptions, the 23 acres of these early experimental plantings became a valuable asset in forest genetics research. This research was aggressively pursued by a number of organizations after World War II and in 1954 led to the founding of the Southern Institute of Forest Genetics on the Harrison Experimental Forest.

### **Watersheds**

H.G. Meginnis reported to the Southern Station in 1929 and began work in an erosion control program. The effort was centered in northern Mississippi where 35 percent of two counties was covered with gullies as much as 100 feet deep

(Wakeley and Barnett, in press). Meginnis quantified erosion and runoff by soil type, compared use of planted pines and other species for erosion control, and applied litter and organic matter to paired watersheds. His research established the protocols used across the South for managing eroded soils and restoring productivity (Meginnis 1933).

Charles Hursh began work at the Appalachian Station in 1926 and led research dealing with erosion control and methods of stabilizing road banks and abandoned agricultural land. In 1932, plots were established at the Bent Creek Experimental Forest near Asheville, NC, to study surface runoff from five representative types of forested or agricultural cover, and an infiltrometer was used successfully with artificial rainfall. These studies led to recognition of the need to establish complete watershed instrumentation to provide for continuous measurements of stream flow and precipitation. As a result, the Coweeta Experimental Forest was established near Franklin, NC, in 1933. Appalachian Station Director C.L. Forsling required a period of standardization of the gauged watersheds. An intensive program of weir construction began in 1934, and a network of 56 standard rain gauges, numerous ground-water wells, and meteorological stations was created. By 1939, calibration of watersheds had progressed enough so that experimentation could begin (Stickney and others 1994). Early studies documented the harmful effects of mountain farming, woodland grazing, and unrestricted logging on soil and water resources (Douglass and Hoover 1988).

### **Forest Economics**

In July 1929, the Southern Station began work in forest economics, having received a special appropriation of \$22,800 from Congress for initiating investigations of financial aspects of timber growing in the southern pine region. E.L. Demmon, Director, in summarizing the early evaluations in "Economics of Our Southern Forests," stated that the value of forest resources in the South greatly exceeded that of any other agricultural crop (Demmon 1937).

### **The War Years**

During the early to mid-1940s, younger men left for military service and older ones spread themselves thin to make measurements and consolidate gains. Many experimental forest areas were closed, and most regular research

was postponed for the duration of the war. The stations had major programs for gathering information about supplies, output, and requirements of forest products for defense for the War Production Board. The stations also assisted war agencies in establishing cork oak (*Quercus sober* L.) plantations, developing Russian dandelion (*Taraxacum kok-saghyz* Rodin) and goldenrod (*Oligoneuron* Small) plants for rubber production, freeing airfields of undesirable vegetation, measuring infiltration rates of soils in connection with airfield drainage, camouflaging military installations, evaluating priority requests for logging and milling equipment, improving fire protection of critical areas, and controlling termites and decay in wood structures (Wheeler 1963).

At the end of World War II (1946), the boundaries of the two stations were realigned. The Southern Station assumed responsibility for research in Tennessee and relinquished Georgia and Florida (South Carolina had already been transferred to the Appalachian Station) to the newly formed Southeastern Forest Experiment Station (formerly the Appalachian Forest Experiment Station).

### **SIGNIFICANCE OF THIS RESEARCH**

With only a handful of professional foresters, and despite little technical support and primitive working conditions, forestry in the South has made tremendous gains. Researchers developed reforestation techniques, studied and began to understand the role of fire in forests, began surveys of the southern forests that led to development and expansion of forest industries, and learned how to control important insect pests and diseases. They also developed an understanding of the importance of the use of statistical design and the value of tree improvement, developed methods for controlling soil erosion, and improved the efficiency of producing forest products. In < 20 years, they provided the basic management guidelines that have resulted in great progress in the restoration of the South's forest lands. In more recent decades, forestry research has refined this knowledge and filled gaps in it. Researchers continue to build on the strong scientific understanding provided by those who preceded them. As a result, our restored southern forest lands are now a primary economic resource in all Southern States.



## LESSONS LEARNED

How did our early research professionals with limited resources accomplish so much in a relatively short period of time? Dedication, cooperation, and teamwork were characteristics of the early research program. Not only did the individuals support each other's efforts, they developed excellent relationships with scientists in universities and other agencies, as well as with foresters in forest industry and State organizations dedicated to solving problems common to all organizations. Wakeley and Barnett (in press) quote a passage in Macaulay's "Horatius" that describes their attitude:

For Romans in Rome's quarrel  
Spared neither goods nor gold  
Nor son nor wife nor limb nor life  
In the brave days of old.  
Then none was for the party.  
Then all were for the State.  
Then the rich man helped the poor  
And the poor man loved the great.  
Then lands were fairly portioned.  
Then spoils were fairly sold.  
The Romans were like brothers  
In the brave days of old!

## CONCLUSIONS

The South's forests were largely overexploited during the early 1900s. Vast areas had been converted to agriculture and then abandoned or were harvested and not regenerated. The knowledge needed for the restoration of these forests was sorely lacking. The establishment of the Southern and Appalachian Stations in 1921 provided the impetus to develop the scientific base for this restoration effort. An important component of this effort was interaction and cooperation with those in universities and forest industry that had the same intense motivation to restore the southern forest lands.

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